FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 85-12

3430 Evaluation
February 26, 1985

BIOLOGICAL EVALUATION OF DARK CANYON CAMPGROUND, SAN JACINTO RANGER DISTRICT, SAN BERNARDINO NATIONAL FOREST

PSW FOREST AND RANGE EXPERIMENT STATION
JUL 12 1985
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ABSTRACT

The Dark Canyon Campground on the San Jacinto Ranger District, San Bernardino National Forest was evaluated for pest conditions. Two primary pests were observed - western dwarf mistletoe on Jeffrey and ponderosa pines and annosus root disease in pine and white fir. Other pests included Elytroderma disease in ponderosa pine, true mistletoe in incense-cedar, and western pine beetle and California flatheaded borer in ponderosa pine. In addition to biotic pests, overstocking was a problem in much of the campground.

Four management alternatives are discussed, including no action, dwarf mistletoe management, annosus root disease management, and vegetation management. No action would result in decline of the present stand condition and conversion of much of the area to white fir as the overstory pines die. Both dwarf mistletoe and annosus root disease management discuss specific measures against each pest. Vegetation management would require the development of an overall plan with specific objectives to be attained. Pest considerations and pest management would be integrated into this plan.

INTRODUCTION

At the request of Charles Irby, Acting Forest Supervisor, we visited the Dark Canyon Campground, San Jacinto Ranger District, San Bernardino National Forest on November 1, 1984. We were accompanied by Heber Williams, District Recreation Officer.

This 22 unit campground is situated in a drainage along Stone Creek. It is generally densely stocked (basal area greater than 500 sq. ft./ac. in some locations), although the northwestern end is more open. The overstory contains large, old-growth Jeffrey and ponderosa pines with a few large incense-cedars, white firs, and sugar pines. The understory contains all of the above species plus live and black oaks. The proportions change, however, with more white firs and incense-cedars in the understory.

A number of pests were observed in the campground vegetation. Specific locations are noted on the enclosed map. The most significant and pervasive pest is western dwarf mistletoe, Arceuthobium campylopodum, on ponderosa and Jeffrey pines. Several isolated, infected trees are scattered in the campground; however, the largest and most severe infestations are located around the entrance Y and around the back side of the loop. Heavily infected overstory trees have large witches' brooms in their lower crown. Understory pines are being infected throughout their crowns.

A pest of limited occurence in the campground, but whose symptoms could be confused with those of dwarf mistletoe, is Elytroderma deformans. This fungus causes a blight of needles and also grows into twigs where it can cause the development of compact, globose brooms that can be mistaken for dwarf mistletoe witches' brooms. Light infections of E. deformans are present in some ponderosa pines, especially along the stream.

True mistletoe, Phoradendron juniperinum ssp. libocedri, was common in many of the large incense-cedars. In some of these trees the infections were numerous and were causing a decline in the condition of the crowns.

Evidence of annosus root disease, caused by Fomes annosus, was observed in both pine and white fir. Most of the evidence were fruiting bodies of the fungus in old stumps. There were no dead trees around these stumps, and in all but one case, there were no nearby hosts that were threatened. One root disease center was observed near Units 14-15. The center had one dead infected white fir sapling and one declining white fir sapling that was also probably infected.

The only current insect activity of note was in a large, dead ponderosa pine near the intersection of the campground road with Stone Creek. This tree had been attacked by the western pine beetle, Dendroctonus brevicomis, and the California flatheaded borer, Melanophila californica. The majority of the western pine beetle brood had already left this tree when we were there.

BIOLOGY OF PEST ORGANISMS

Western dwarf mistletoe (Arceuthobium campylopodum). Western dwarf mistletoe infects Jeffrey, ponderosa, knobcone, and Coulter pines. Other native conifers or hardwoods are not infected by this particular species. Dwarf mistletoes are obligate parasites that are dependent on their host for support, water, and most of their mineral and organic nutrients. They often cause the formation of "witches' brooms", or dense masses of distorted branches, on the host that divert nutrients from the rest of the tree. Infection can cause growth reduction, abnormalities, mortality, and predisposition to attack by other pests. In particular, infected trees are more susceptible to attack by bark beetles and the California flatheaded borer. The dwarf mistletoe/bark beetle complex is responsible for 40 to 60% of the pine mortality in southern California during years of normal precipitation. Mortality is more severe when other stress factors occur, such as drought, poor site, or competition in overstocked stands.

Dwarf mistletoe spreads between trees and within crowns of trees by means of small seeds that are forcibly ejected into the air. Spread from overstory to understory is limited to the distance the seeds are shot - generally 20 to 60 feet, but as much as 100 feet if assisted by wind or on steep slopes. Dwarf mistletoe spreads upward in pine at an average rate of 4 inches per year.

Annosus Root Disease (Fomes annosus). Fomes annosus is a fungus that attacks a wide range of woody plants, causing a decay of the roots and lower bole and death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed. In a few instances, madrone (Arbutus menziesii) has been attacked. Infected pines are usually killed rather rapidly when the fungus girdles the root collar. Older true firs and incense-cedars usually survive infection for many years, although butt and root rot may become extensive, resulting in tree weakening and windthrow.

During favorable periods, the fungus forms fruiting bodies in decayed stumps, under the bark of dead trees, or in the duff at the root collar. The fungus becomes established in freshly cut stumps from air-borne spores produced by the conks, and then grows into the root system. True fir can also be infected by spores invading fresh basal wounds. The fungus subsequently spreads to healthy roots of surrounding susceptible tree species via root contacts. In general, infections will cross from pine to true firs; however, rarely is the fungus observed to go from true fir to pine. Local spread of the fungus from a stump typically results in the formation of disease centers, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach barriers such as openings or groups of nonsusceptible plants.

The fungus may remain alive for 50 years as a saprophyte in infected roots and stumps. Young susceptible tree species often become infected and die after their roots contact old infected root systems in the soil.

Elytroderma Disease (Elytroderma deformans). In California, Elytroderma disease is mainly a disease of Jeffrey and ponderosa pines. It has been found occasionally on knobcone, lodgepole, and pinyon pines. The fungus causes the premature death of 1-year-old needles, and a brooming and deformation of infected twigs and branches. It can cause mortality of infected twigs.

The disease is spread by fungal spores that are released in late summer and early fall from fruiting bodies borne on the infected needles. Under suitable conditions, the spores germinate and infect the current year's needles of susceptible hosts. The fungus spreads from the needles into the twigs. The following spring the infected needles die and fruiting bodies begin to develop. The infection within the twigs spreads into the growing tips and buds, where it can cause a brooming and deformation of future growth. Broom formation occurs most commonly on vigorous trees.

The effect of the disease depends on the proportion of the host crown that is infected. There is little effect upon the host until more than two-fifths of the twigs are symptomatic. The disease is most severe on seedlings, saplings

and poles with poor crowns. Although direct killing of mature trees by this disease is infrequent, moderate to severe infection predisposes the host to other diseases and to bark beetle attack.

Western Pine Beetle (Dendroctonus brevicomis). The western pine beetle is the most damaging bark beetle of ponderosa pine in California. If an attack is successful, the adults mate under the bark in the phloem-cambium region of the tree bole. Eggs are laid along winding galleries and after a short incubation period, the eggs hatch and the tiny larvae chew their way into the outer bark where they complete their development. The beetle may complete two to three generations per year. Usually, tree killing by the western pine beetle is related to one or more predisposing factors, including stress caused by overcrowding, drought, disturbance, injury (such as road construction, logging damage, fire, or lightning), and tree diseases (such as dwarf mistletoe and root diseases).

Ponderosa pine trees are randomly visited by adult western pine beetles. Healthy, vigorous trees may be attacked, but usually, the attacks are unsuccessful. If trees are of low vigor, the initial attacks may be successful. If this happens, the "pioneer" beetles release an aggregating pheromone and the tree becomes the center of a mass-attack. Depending on the proximity of other ponderosa pine trees to this center, additional trees may be killed, causing a dead tree group to occur.

MANAGEMENT ALTERNATIVES

1. No Action. The spread of dwarf mistletoe will continue, both outward from the large infestation and from the small isolated pockets. It will also intensify in individual trees as vertical spread exceeds the rate of height growth of many of the trees. The more heavily infected trees will have increased susceptibility to successful bark beetle attacks. Overmaturity, overstocking, compaction, and periodic drought will increase this susceptibility. Understory pines will be severely affected as they are annually exposed to additional infection from overhead. Height growth will be limited, as will the value of the trees as future replacements.

Loss of the pines from the overstory will release the more shade-tolerant white firs and incense-cedars in the understory, resulting in a changed vegetative condition. The increased size of these tolerant trees, especially the white firs, will result in greater hazard potential because of the increased decay susceptibility of white fir and the hazard of root infection by Fomes annosus. White fir also tends not to reach the large size in these dryer environs, but is attacked by the fir engraver, Scolytus ventralis, while still of small to medium sawtimber size. This susceptibility increases during droughty periods.

Additional annosus root disease centers may develop as dead and hazard trees are removed. Since both strains of the fungus appear to be present, all conifer species will be susceptible to infection and mortality. New centers, as well as existing ones, may develop into openings as trees die and are removed. Conifer regeneration in these openings will be highly susceptible to infection and premature mortality.

In addition to the long term effects of the diseases present, overstocking and public use will have negative effects on the vegetation. These factors will increase the stress on the trees and weaken some of them sufficiently for successful bark beetle attacks. Periodic droughts will add an additional stress on these trees. Bark beetle activity and tree mortality will increase during these times.

2. Dwarf Mistletoe Management. Two general approaches are available to manage the dwarf mistletoe in the campground -- eradication and suppression.

The only effective method of eradicating dwarf mistletoe is through host removal. This may not be possible in much of the campground because of the number, size, and stature of the trees involved and the effect their removal would have on the visual conditions. Eradication may be more acceptable in the small, isolated, infected areas. These areas involved only a few trees and their removal might not adversely affect the campground. Spread and intensification of the mistletoe in these areas would, therefore, be eliminated as a problem. In addition to treating isolated areas, a similar effort may be effective around parts of the margin of the larger infested area. In some areas, removal of one or two infected pines may create a sufficiently wide non-host buffer to prevent further outward spread, especially if there are non-host overstory trees present that might intercept dwarf mistletoe seed, as well as act as vegetative cover.

In the large infested area, suppression is a reasonable approach to lessening the impact of dwarf mistletoe. Suppression includes tree removal and pruning infected branches. Heavily infected trees with dwarf mistletoe throughout most of their crown should be removed. Pruning infected branches from these trees would remove too much crown to assure tree survival. General branch pruning of overstory trees without removal of all dwarf mistletoe is of little value. Branch pruning of understory trees, where infections are in the lower crown and the overstory source of dwarf mistletoe seeds has been removed, may lessen some impacts and permit more rapid height growth free of infection.

In areas of the campground where dwarf mistletoe eradication is not possible and removal of the overstory source of infection cannot be accomplished, then pruning of witches' brooms can be beneficial. The purpose of this operation is to lengthen the expected life span of selected trees that have special value to the campground. Only the large witches' brooms, usually in the lower crown, would be pruned. This type of pruning is not recommended for heavily infected trees. In any pruning operation, no more than 50% of the crown should be removed and at least a 30% live crown ratio should exist after pruning.

Following either eradication or suppression efforts, additional treatments may be necessary in 3 to 5 years to assure achievement of objectives. Latent infections and those not originally seen may require this additional treatment, especially in areas of eradication.

3. Annosus Root Disease Management. Prevention is the key to managing annosus root disease and is easily accomplished in campgrounds. Application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-96) to the stump tops of freshly cut conifers is an effective prophylaxis against infection and the establishment of new root disease centers.

Established root disease centers are more difficult to manage because of the underground nature and persistence of the fungus. Most of the centers in the campground do not appear to actively involve surrounding trees. They may have ceased expanding. However, the existence of the fungus on the site is a continuing threat to any regeneration. Centers established in white fir are a threat only to that species, while centers in pine are a hazard to any conifer regeneration. Therefore, if the District plans to regenerate any of these openings, only oaks should be planted in the pine infection centers. Oaks and pines are acceptable in the centers established in white fir.

Active centers where mortality is ongoing also should not be regenerated with conifers. In addition, large white firs within and around the margins of centers, active or not, should be closely monitored for decay and root weakening that could lead to tree failure. Poor crown condition, leaning, and soil heaving are indicative of potential failure.

4. Vegetation Management. A vegetation management plan that addresses the condition of the vegetation and the recreation objectives would be developed. Pest management considerations would be included in this plan and subsequent actions taken to implement it.

What appears to be the most urgent need for the campground is to achieve stocking levels more appropriate to the site. A thinning, generally from below would accomplish this. Since most of the trees removed would be white fir, fewer problems with this species would occur in the future. A number of criteria should be used when marking trees for removal. Included are suppression, defects, species, spacing, aesthetics, and general health. When selecting trees for removal, dwarf mistletoe management objectives could also be accomplished. Removing the more heavily infected pines would reduce the exposure of surrounding pines to infection and lessen the opportunities for bark beetle spots to develop centered around the heavily infected trees. If eradication is attempted in the isolated infection centers, it would also function to an extent as a thinning.

In addition to tree removal, regeneration may be necessary in selected areas to ensure adequate numbers of replacement trees. Regeneration efforts should emphasize pines, including ponderosa, Jeffrey, and sugar, and oaks. In annosus root disease centers in pine, either live or black oak could be planted. Larger container grown stock may be necessary to assure survival. A few deep waterings the first summer would also increase the chance for survival. Care should be taken to educate the public about such efforts, so that seedlings may be protected from abuse.

Any actions, such as thinning, that produce green pine slash should consider pine engraver beetles (Ips spp.). Rapid utilization of the slash or treatments to prevent engraver beetles from breeding in the slash should be taken. Treatments include limiting slash producing activities to early July through January, lopping and scattering slash in openings, piling and burning slash while green, piling in openings and covering tightly with clear plastic, or any other treatment that speeds the dessication of inner bark or removes the bark from the wood.

If any tree removal activities are undertaken, either for thinning, dwarf mistletoe management, or hazard tree removal, care must be taken to protect the residual trees from damage. This is especially important for white fir during falling and skidding. If a white fir is wounded, its removal during the operation should be considered because of the likelihood of decay and increased hazard potential.

The management strategies discussed previously for dwarf mistletoe and annosus root disease should be integrated into the vegetation management plan. Implementation of such a plan will increase the lifespan of selected trees, reduce tree mortality and the number of hazard trees, provide replacement trees, and improve the overall health and vigor of the stand.

DARK CANYON CAMPGROUND
KEY TO PEST LOCATIONS ON MAP

1. Ponderosa pine attacked by western pine beetle and California flatheaded borer.

2. Pocket of western dwarf mistletoe in hard pines.

3. Pocket of western dwarf mistletoe in hard pines.

4. Fomes annosus conks in pine stump - no visible effect.

5. Fomes annosus conks in pine stump - no visible effect.

6. Fomes annosus conks in pine stump in small opening - 1 dead white fir sapling infected, one green white fir sapling appears infected.

7. Fomes annosus conks in fir stump next to drainage - no visible effect.

8. Fomes annosus conks in fir stump - no visible effect. Light infestation of Elytroderma deformans in ponderosa pine in vicinity, especially along stream.

9. Pocket of western dwarf mistletoe in hard pines.

EXHIBIT 4

DARK CANYON CAMPGROUND